

**Workplace stress measured by Job Stress Survey and  
relationships to musculoskeletal complaints**

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## Abstract

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The main purpose of this thesis was to evaluate and test the Job Stress Survey (JSS, Spielberger, 1991; Spielberger & Vagg, 1999), a self-report instrument which assesses workplace stress. In the thesis a thorough evaluation is made of JSS scales and items, and the relations to health, particularly musculoskeletal complaints. The aim of **Study I** was to evaluate the factor structure and the psychometric properties of a Swedish version of the JSS. The instrument was distributed to medical service personal and metal industry workers (n=1186). Factor analyses demonstrated a good resemblance between the present version and the American original version. The results also showed that the internal consistencies, as well as the test-retest reliabilities of the scales are high, and the concurrent validity are good. **Study II** examined work-related stress measured by JSS for the subgroups of gender, industry workers and medical service personnel, and special attention was given to the problem of differential item functioning (DIF) on these subgroups. The main findings were that both gender and occupation has a substantial impact on specific sources of work-related stress assessed by JSS scales and individual items. The result of the DIF analyses showed no item bias in the gender subgroup, but for the occupational subgroups there were items showing DIF in two of the scales. These items do not jeopardize the conclusions made on scale level since the number of items showing DIF are too few to make an impact on the overall result on the different scales. In **Study III** the relation between self-reported stress and health, particularly musculoskeletal problems were examined longitudinally in two metal industry factories. Results showed high levels of stress and musculoskeletal complaints in these factories and significant and strong relationships between the JSS scales and musculoskeletal, as well as psychosocial ratings. Lack of Organizational Support was found to be more related to musculoskeletal pain than Job Pressure. Longitudinal differences were found between the factories and between different types of musculoskeletal complaints. The general conclusions from the studies are that the present version of JSS shows a good resemblance with the American original, and that JSS is a useful instrument for studying relationships between stress and health.

**Key words:** Job stress, Job Stress Survey, work-related stress, musculoskeletal complaints, metal industry, differential item functioning, medical service, longitudinal.

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Villa til' I die!

Umeå, April, 2008

Stefan Holmström

## LIST OF PAPERS

This doctoral dissertation is based on the following articles:

- I. Holmström S., Molander, B., Jansson, J., & Barnekow-Bergkvist, M. (2008). Evaluation of a Swedish version of Job Stress Survey. *Scandinavian Journal of Psychology*, 49, 277-286.
- II. Holmström, S., Molander, B., & Barnekow-Bergkvist, M. (2007). *Gender, occupation, and item bias: Job stress assessed by Job Stress Survey*. Manuscript submitted for publication.
- III. Holmström, S., Molander, B., & Barnekow-Bergkvist, M. (2008). Work-related stress and musculoskeletal problems in metal industry: A longitudinal study. Manuscript.

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## INTRODUCTION

Work-related stress and health, and especially musculoskeletal problems are an increasingly common feature of modern life. Research has clearly established a relationship in occupational stress between high levels of stress and negative effects on health, productivity, and well-being of employees (e.g., Hurrell, Nelson, & Simmons, 1998; Karasek & Theorell, 1990; Murphy, Hurrell, Sauter, & Keita, 1995; Quick, Quick, Nelson, & Hurrell, 1997; Wright & Smye, 1996). Musculoskeletal problems arise in virtually all workplaces, even though preventive measures, for example in the ergonomic work environment has been accomplished. Risk factors for developing musculoskeletal problems can be divided into three categories of factors; (1) physical, (2) psychosocial, and (3) individual (Ariëns, van Mechelen, Bongers, Bouter, & van der Wal, 2001). Reviews of studies of the first two categories (e.g., Ariëns, van Mechelen, Bongers, Bouter, & van der Wal, 2000; Ariëns et al., 2001; Hoogendoorn, van Poppel, Bongers, Koes, & Bouter, 2000; Larsson, Sjøgaard, & Rosendal, 2007; van der Windt et al., 2000) revealed that physical factors, such as repetitive movements, awkward postures, high force demands, work posture, vibration and psychosocial factors, such as low co-worker support, high quantitative demands, low job control and low job satisfaction are of importance. These factors might be associated with musculoskeletal disorders directly, or as a consequence of raising the level of stress in the work place. It is well known that high level of stress is related to musculoskeletal complaints and pain (e.g., Lundberg et al., 1994; Siivola et al., 2004).

Individuals and organizations face mounting problems of managing work-related stress and illness, but they lack in understanding of the nature of occupational stress (Williams & Cooper, 1998). There are some problematic circumstances with the occupational stress field; one problem is that the term stress is imprecise and misused. Another problem is the lack of consistency in measurement tools. The measurement instrument should also help raise awareness of occupational stress at both individual and organizational level it should identify individuals who need remedial help, and it should provide information for the design of appropriate interventions (Williams & Cooper, 1998). The absence of valid, reliable and standardized instruments make studies of occupational stress highly problematic (Love & Beehr, 1981), and the lack of standardization makes approaches to measurement across occupations and companies difficult (Williams & Cooper, 1998). Creating measurement instruments which can serve as comprehensive diagnostic tools and which can be used by all

employees within organizations and companies are a challenge and an important task.

Job Stress Survey (JSS, Spielberger, 1991; Spielberger & Vagg, 1999) is a measurement instrument which is constructed to measure generic sources of occupational stress encountered by employees in a wide variety of work settings, settings that often result in psychological stress (cf. Jackson & Schuler, 1985). One of the objects of this thesis is to make a thorough evaluation of the factor structure and psychometric properties for the JSS, and a Swedish version of the questionnaire. Rick, Briner, Daniels, Perryman, and Guppy (2001) have in their review of self-report instruments found that there have been relatively little data published on the psychometric properties of the JSS, and therefore it is hard to fully assess the strength of the instrument. In studies the JSS instrument has been shown to be related to factors such as job satisfaction, personality, and health (Bongard & al'Absi, 2005; O'Roark, 1995; Turnage & Spielberger, 1991).

When instruments of the self-report type are designed or when they are evaluated care must be taken so that measurements are appropriate for different important subgroups (e.g., gender, age, occupation, occupational level). This is important in order for no item to be more difficult, discriminating, or easily guessed for one group than for another. If, for example, there are items which differentiate in response patterns between important subgroups it could be a sign of item bias known as differential item functioning (Smith, 2002; Swaminathan & Rogers, 1990; Zumbo, 1999). In this thesis the participants in the different studies are employees from metal industry and medical service sector. A further aim of this thesis is to evaluate the relation to health, and, in particular, musculoskeletal complaints.

## RESEARCH OBJECTIVES

This research project includes studies with different aims as presented below.

- I. The main purpose of the first study is to evaluate a Swedish version of Job Stress Survey (Spielberger & Vagg, 1999). The focus is on the psychometric properties of the instrument and to what extent it is possible to verify the original factor structure in the present version.
- II. In the second study the main purpose is to analyse a Swedish version of JSS (Holmström, Molander, & Barnekow-Bergqvist, 2004; Holmström, Molander, Jansson, & Barnekow-Bergqvist, 2008) with special attention to the problem of differential item functioning. Perceived severity, frequency, and overall occupational stress for subgroups of gender and occupation (assembly industry workers and medical service personnel) are analysed.
- III. The main purpose of Study III is to examine a Swedish version of JSS (Holmström et al., 2004; Holmström et al., 2008) with respect to relationships with health, in particular musculoskeletal complaint over a four-year period.

## THEORETICAL FRAMEWORK

### **Background to the concepts of stress and occupational stress**

One important thing in research is to possess knowledge of the history of the actual fields of research, to understand how we got to the point where we are now. It is important to emphasize that stress research developed historically in two largely separate spheres, a physiological and a psychological sphere (Mason, 1975a). Occupational stress as a field of investigating job conditions and their consequences on performance and health is a relatively new research field, which crystallized in the early 1970's. However, the roots of the occupational stress concept can be traced back to Selye's (1936) research on animals, and Cannon's (1929) work on the physiological concomitants of emotion. In 1930's Selye discovered that a wide variety of noxious stimuli, such as exposure to extreme temperatures, physical injury, and injection of toxic substances evoked an identical pattern of physiological changes in the laboratory animal he used. These noxious stimuli Selye later referred to as stressors. Selye (1936; 1967; 1974) found that regardless of stressor the response patterns were the same non-specific reaction. Some years later Selye (1946) named this somatic response the General Adaptation Syndrome (GAS), and defined stress as the non-specific body response to any stressor and demand made upon it.

Cannon (1914; 1929) laid the base for the understanding of how various emotional states affect physiological functions and diseases by describing the "fight or flight" response. This response has played an important role in stress discourse (Doublet, 2000). Another perhaps equally important development by Cannon (1935), is the concept of physiological homeostasis.

In the beginning Selye used the term "nocuous agent" but he felt that it did not capture the real essence, and he looked for a more suitable term, and Selye adopted the term "stress" instead. Drawing on an engineering analogy the non-specific response was the biological equal of what has been called "stress" in lifeless objects. Mason (1975a) points to the fact that it is quite difficult to trace Selye's own evolution about the use of the term "stress". At different periods during his development of the "stress" concept, Selye has defined "stress" differently in terms of stimulus, response or interaction between stimulus and response. From the psychological paradigm came criticism. Lazarus (1977), for example, argued that Selye had failed to take into account the psychological signalling system, which distinguishes between dangerous events and

harmless ones. When the researchers in the field began to focus more and more on the psychological factors of stress, Selye tried to generalise many of his physical factors to psychological factors (Doublet, 2000) and saw stress as a psychological response within the organism. Selye has admitted that when he started working on the stress concept he gave little thought to its psychological or sociological implication, because for him stress was a purely physiological phenomenon (Selye, 1983). The physiological approach to understand stress has had an enormous impact on stress research. The work of Selye and Cannon has made important contributions to the research field, and modern approaches to job-stress assessment can be traced back to them and their work (Hurrell et al., 1998).

Richard Lazarus has been one of the most important and influential persons in the psychological development of the field of stress (Cooper & Dewe, 2004). Lazarus and his colleagues noticed how one person who reacted in a stressful situation did not necessarily want others to react in the same way. To understand what happens between experiencing a stressor and the reaction of the stressor one has to take variables such as individual differences (e.g., goals and values), motivation, and earlier experiences of similar situations into account (Lazarus, 1993). Lazarus introduced the concept of cognitive appraisal, which is of importance for understanding the differences in experience (Lazarus, 1966; Lazarus & Folkman, 1984). This concept is central in the Transactional Process Model, which will be reviewed in more detail later on. Cognitive appraisal can be defined as the process which translates objective events into perceptual experiences. This is an important contribution to the understanding of subjective factors and how they can play a much larger role in the experience of stress than objective factors.

Occupational stress or work stress has a relatively brief history in scientific discourse. In work settings, stress can be produced by an array of stressors, such as work tasks, psychosocial, and organizational stressors (Murphy, 1996). The earliest definitions of work stressors were related to role conflicts and role ambiguity. These stressors dominated the occupational stress research in the 1960s and 1970s. The first self-report questionnaire for measuring role conflict and role ambiguity was created in the early 1970s. At that time the Person-Environment Fit model (French, 1973; French & Caplan, 1972; French, Caplan, & Van Harrison, 1982) was introduced and has become one of the most influential and used models of stress (Eulberg, Weekley, & Bhagat, 1988). The Person-Environment Fit model concentrates on the relation between person and environment. The goodness of fit in these relationships are of

importance, and misfit in the relationship can lead to psychological stress and ill-health (Caplan, 1987; French et al., 1982; Harrison, 1978, 1985).

There is another stress model which has had even greater impact in the field of stress (Kristensen, 1995), namely Karasek's (1979) Demand-Control model. This model is a synthesis of two research traditions; from stress research the model inherited the notions of qualitative and quantitative job demands, and from sociology it inherited the notion of control (Karasek & Theorell, 1990). The intention with the Demand-Control model was to provide a framework for analyses of the way in which work is organised, and how it relates to alienation and ill-health among employees. A further and more detailed description of these two models will be presented later on.

The psychosocial contribution to the field of occupational stress has helped creating a more complex picture of the field, through the dynamic interaction between environmental and individual conditions. One problem with studies of occupational stress is that they have been plagued by confusing and inconsistent definitions of the variables of the stress process. Seyle has been criticised for the label stress (e.g., Kasl, 1987a; Mason, 1975a, 1975b), but he has tried to resolve differences and bring clarity. Seyle stated once: "I certainly did not discover stress, but only the stress syndrome" (1975, p. 38). Mason (1975a) regards it as remarkable that the term stress has been so persistent, and given such a widespread usage in biology and medicine in spite of disagreement over its definition. Seyle (1976) agrees that the concept of stress is abstract, but even so he thinks that the concept has an value. He makes a comparison with life: "Stress is an abstraction; but so is that of life, which could hardly be rejected as irrelevant to the study of biology" (Seyle, 1976, p. 49). Seyle continues to say that there is no one who has studied life in a pure uncontaminated form. It is always inseparably connected to something else which is more concrete and seemingly more real (Seyle, 1976, p. 49). Kasl (1987a) is in agreement with Mason, and goes one step further, thinking it is time to abandon the stress concept altogether.

There are limitations in current theories and measurement instruments of occupational stress. One major problem is that most theories of occupational stress reside in how occupational stress and strain are defined and measured (e.g., Kasl, 1978; Schuler, 1980). If theoretical concepts are ambiguous or undifferentiated, it is difficult to interpret which aspect of job stress and strain that has been assessed (Vagg & Spielberger, 1998). Different measures of stress assess different dimensions of occupational stress, individual differences in ability, personality characteristics, coping skills, and social support. These are all important

dimensions for understanding the impact of stressful job-related events on individual and group level. Another issue in several measures of work-related stress is that test items are lengthy or multidimensional in content.

As earlier remarked there are different approaches in defining stress. This can lead to problems for researchers in different traditions. In fact, scientists from medical and behavioural fields may have difficulty understanding each other when discussing stress. This difficulty is mainly caused by fundamental differences in the definitions of stress, even if both traditions originate from the research of Seyle and Cannons. Despite the confusions and inconsistencies between different traditions there are important overlaps between them. Also, physiological stress and psychological stress need completely different levels of analysis (Lazarus, 1966; Lazarus & Folkman, 1984). For example, what generates physiological stress is not the same as what is stressful from a psychological point of view (Lazarus, 1993). Zautra (2003) points to the fact that each discipline has developed the concept using their own special meanings, but has little knowledge of the complexities that exist in other traditions.

### **Assessing occupational stress**

Occupational stress can be assessed in several ways, for example by ratings made through observation, by measures of production, by self-reports, and by interviews. The most common type of measurement when assessing occupational stress is self-report measures (see e.g., Rick et al., 2001). Examples of such instruments are Job Content Questionnaire (Karasek, 1985), Job Diagnostic Survey (Hackman & Oldham, 1975), Job Stress Survey (Spielberger, 1991; Spielberger & Vagg, 1999), Occupational Stress Indicator (Cooper, Sloan, & Williams, 1988), Occupational Stress Inventory (Osipow & Spokane, 1987), Pressure Management Indicator (Williams & Cooper, 1998) and QPSNordic (Dallner et al., 2000).

Questions have been lifted by some researchers (e.g., Frese & Zapf, 1988; Kasl, 1978, 1987a, 1987b, 1998) about the reliance of subjective ratings when assessing occupational stress. Frese and Zapf (1988) propose that there is a risk that trivial correlations occur in measures of self-reported stress and health because of method variance or overlap between the items in terms of content. These authors believe that the way out of this problem is to use objective measures, and the use of objective measures of stress would give a better and broader picture of stress in working life. Critics on the other hand, state that measures of objective occupational stressors are not often easy or even possible to obtain (Hurrell et al., 1998), and Karasek and colleagues point out that it would take an outside observer much time to identify and evaluate the social

support situation of the worker (Karasek, Brisson, Kawakami, Houtman, & Bongers, 1998). Several studies (e.g., Helmer, Barberger-Gateau, Letenneur, & Dartigues, 1999; Lundberg, 2006; Miilunplao, Vuori, Oja, Pasanen, & Urponen, 1997) have found that self-rated health measures predict future health and life expectancy as well, or even better, than medical examinations do. Kasl (1998) finds the discussion over subjective and objective strategies of measures to be quite imprecise and unnecessarily polarizing. The arguments from the discussion can be summarized as follow, measures of self-report tend to be easily obtained, cheaper, and more convenient. Whereas, objective measures, are more expensive, clumsy, and difficult to obtain. The two measurement strategies won't need to be competing with each other, they could give the researcher important and complementing information, which help the understanding and evaluation with an extended perspective on the occupational stress in the actual organizations.

Measuring instruments in occupational stress can be categorised into three groups, there are measures which assess job stressors, strains, and health outcomes (Hurrell et al., 1998). Job stressors relates to a large number of work-related environmental conditions regarded as having an impact on the health and well-being of the employee. Strain is about the employee's psychological and physiological reactions to such exposures. Health outcomes refer to negative health conditions thought to result from exposure to job stressors.

It is not the demand or the source of stressor itself that is the issue; it is the perception of that stressor (Cox, 1978; Lazarus & Folkman, 1984) and the intensity of stressor (DeFrank, 1988; Dewe, 1989). Stressors perceived as very severe and appearing with high frequency are more likely to produce greater strain, thus contributing to the development and progression of stress-related illnesses (Vagg & Spielberger, 1999). Failure to take into account how often a stressor is experienced by an individual increases the risk for an overrating of highly stressful events that occur infrequently, while underestimating the impact of moderately stressful events that frequently occurs. For example, if a co-worker is killed in a workplace accident this would be extremely stressful for other employees at the workplace. However, this highly stressful event is rarely experienced, and therefore contributes relatively little to the overall experience of stress at the workplace. In contrast, even though excessive paperwork is only moderately stressful for most employees, it occurs with very high frequency; therefore it contributes substantially to the overall experience of stress.

## **Background and development of the Job Stress Survey**

The Job Stress Survey (JSS, Spielberger, 1991; Spielberger & Vagg, 1999) was designed to measure generic sources of occupational stress encountered by employees in a wide variety of work settings. Each of the JSS items illustrates a generic and job-related event, and JSS follows Murphy and Hurrell's (1987) plea for occupational stress instruments to measure a core set of questions.

Prior to the constructing of the JSS, Spielberg and colleagues (Grier, 1982; Spielberger, Grier, & Pate, 1980; Spielberger, Westberry, Grier, & Greenfield, 1981) had developed the Police Stress Survey (PSS), and the Teacher Stress Survey (TSS) to measure work-related stressors encountered by law enforcement officers and high school teachers. When developing the PSS, focused groups consistent of police officers helped to selected items from a large pool of items which had been derived from a comprehensive review of police stress literature (Spielberger et al., 1981). The PSS were used as a guide when the TSS was constructed, and from the 60 items included in the PSS, 39 items were considered to be equally applicable for work in schools and police work (Grier, 1982). The TSS items were identical to corresponding PSS items, except that "school" and "teacher" were substituted for "department" and "police". The TSS items were also reviewed and approved by an advisory committee of experienced high school teachers. This committee also reviewed a pool of 50 supplementary items generated from the literature on teacher stress. From the additional pool, 21 items were selected and added to the 39 items adapted from the PSS to form the 60-item TSS.

The JSS instrument has been developed from the PSS and the TSS to measure occupational stress (Spielberger & Vagg, 1999). There were 39 items that were found to be equally suitable for assessing job stress in both teachers and police officers. Thirty of these items, which were judged to be most applicable to a broad range of work situations, were elected and adapted to form the JSS. The JSS items focus on aspects of work situations that are likely to be encountered by workers in widely different occupational settings, and in settings which are likely to result in psychological strain. The selection of the items was based on extensive research on the perceived severity and frequency of occurrence of stressors experienced by teachers and police officers, but also by managerial, professional, clerical, and maintenance workers (Grier, 1982; Spielberger et al., 1980; Spielberger & Vagg, 1999).

This work fulfilled the Murphy and Hurrell (1987) request for an instrument to measure generic stressors that facilitates comparing levels of stress between different occupational groups, and the Jackson and Schuler

(1985) request that items should focus on aspects of work that often result in psychological strain. Spielberg and colleagues also followed the recommendation by DeFrank (1988) and Dewe (1989) that more attention should be given to both severity and frequency of job stress. Ratings of the perceived severity of a particular stressor give information about the impact of the stressor event on the worker's emotional state at that moment. Examining the frequency of occurrence of a particular occupational stressor provides traitlike data on how often the individual has responded to that stressor. Spielberger (1983; 1988) views the difference between the perceived severity of stressors events and how often they are encountered as similar to differentiating between emotional states and personality traits.

### **Conceptual models of occupational stress**

The relationship between characteristics at work and employee well-being has attracted considerable attention in the job stress literature. During the years a number of conceptual models have been developed that relate job characteristics to the health and well-being of working. It is among these models we will find the theoretical framework for the JSS instrument (Spielberger, 1991; Spielberger & Vagg, 1999).

The Person-Environment fit theory approach to stress (French, 1973; French & Caplan, 1972; French et al., 1982) is one of the pioneer models and also most widely accepted among organizational stress researchers (Eulberg et al., 1988). Two other theoretical frameworks have been particularly successful in generating and guiding job stress research: the Job Demand-Control Model (Karasek, 1979, 1998; Karasek & Theorell, 1990) and the Model of Effort-Reward Imbalance at work (Siegrist, 1996, 1998). The Transactional Process Model (Lazarus, 1966, 1991; Lazarus & Folkman, 1984, 1987) is a cognitive-motivational-relational theory, which focus on the individuals own appraisals of different events or environments (stressors).

### **Person-Environment fit**

The Person-Environment fit (P-E fit) approach characterizes stress as a lack of correspondence between characteristics of the person (e.g., abilities, values) and the environment (e.g., demands, supplies). The central hypothesis of P-E fit is that misfit between person and environment leads to psychological, physiological and behavioural outcomes which can increase the risk for morbidity and mortality (Caplan, 1987; French et al., 1982; Harrison, 1978, 1985). Occupational stress research guided by the P-E fit model has investigated a wide range of content, as, for example,

job satisfaction, job and organizational characteristics, individual differences in attitudes, health status, employee skills and traits (Beehr & Newman, 1978; Cooper & Cartwright, 1994; Jackson & Schuler, 1985; Sharit & Salvendy, 1982).

The outcome of the P-E fit can take two separate versions. One version focuses on the correspondence between personal skills, abilities, and environmental demand (i.e., Demands-Abilities fit). The other version focuses on the correspondence between environmental supplies and personal values, motives, and goals (i.e., Supplies-Values fit). These two types of fit (S-V and D-A fit) are often discussed together under the heading of P-E fit (Dawis & Lofquist, 1984; French et al., 1982). The S-V and D-A fits are fundamentally different, both in terms of their underlying processes and their associated outcomes. The differences in process are implicit in the components that constitute the S-V and D-A fits (Edwards & Cooper, 1990). That is, the D-V fit suggests a process where the individuals have to assemble their abilities and skills to meet the demands of the environment. The S-V fit suggests another type of process where individuals draw from their personal value structure to cognitively evaluate the surrounding environment. These processes may be causally related, as when an individual needs to satisfy environmental demands in order to achieve valued states, but the processes are conceptually different.

There are differences in outcome. When environmental supplies deviate from individual values, this can lead to dissatisfaction (Locke, 1969, 1976), negative affect (Diener, 1984), and other negative well-being symptoms. In contrast, when environmental demands exceed individual abilities, the individual's performance is likely to decrease (Hackman & Oldham, 1980; Naylor, Pritchard, & Ilgen, 1980). In some cases well-being may be directly influenced by the D-A fit, as when meeting environmental demands is inherently valued by the individual (French et al., 1982). The S-V and D-A fits are different versions of P-E fit, both in terms of underlying processes and associated outcomes. Studies of P-E fit often neglect these distinctions, and in some cases overlook them entirely. This leads to theoretical and methodological research problems, which limits the conclusiveness of the findings. The theoretical and methodological problems comprise inadequate distinction between different versions of fit, confusion of different functional forms of fit, poor measurement of fit components, and inappropriate analysis of the effects of fit (Chemers, Hays, Rhodewalt, & Wysocki, 1985; Edwards & Cooper, 1990; Fletcher & Jones, 1993).

### **Job Demand-Control-Support model**

Karasek (1979) originally developed the Job Demand-Control (JDC) model from conflicting findings in two research traditions. The JDC model is a situation-centred model, and the model identifies psychological job demands and job control (or decision latitude) as two primary job sources which can lead to stress at work. Karasek defined job demands as psychological stressors presented in the work environment (e.g., high working pace, high time pressure, difficult and mentally exacting work). Job control refers to the individual's ability to control his or her work activities (Karasek & Theorell, 1990). Decision latitude consists of two aspects, namely the width of skills used by the workers on the job (skill discretion), and the workers authority to make own decisions on the job (decision authority). Decision latitude is a term which has at times been used as an alias for job control. Henceforth only the job control term will be used which includes the decision latitude.

In the JDC model there are two different hypotheses, the strain hypothesis and the learning hypothesis. The model assumes that having control over the work process will reduce stress and increase learning, while psychological demands will increase both stress and learning. The strain hypothesis states that psychological strain and physical illness are expected in the combination between high demands in work and low control of the work process. The learning hypothesis states that high demands in combination with high control leads to increased learning, motivation, and development of skills. Another perspective of the JDC model implies that control can buffer negative effects of high demands on health and well-being.

In the eighties the model expanded with a social dimension (Johnson & Hall, 1988; Johnson, Hall, & Theorell, 1989), and this expansion was soon accepted by the creator of the JDC model (Karasek & Theorell, 1990). The Job Demand-Control-Support (JDSC) model acknowledges that social support is vital for the employee when coping with different demands at work. The social support dimension makes a distinction between isolated jobs (jobs with few opportunities for social interaction), and collective jobs (jobs in which interactions with co-workers are integrated) (Johnson, 1989).

The evolution of the JDC model to the JDSC model has meant that the two hypotheses have been slightly reshaped (Karasek & Theorell, 1990). The "iso-strain" hypothesis predicts that jobs which are characterized by high demands, low control, and social isolation lead to more illness, both psychologically and physically. The buffer hypothesis

states that job control and worksite social support moderate the negative effects of high demands on the employees well-being.

Both the JDC and the JDCS models have been evaluated in many studies. The models themselves, as well as the inconsistent empirical findings of the models, have generated an impressive amount of both theoretical and methodological criticisms (c.f., Kristensen, 1995). It has been argued that the JDC(S) model is a “male” model because women are less vulnerable to (iso)strain than men (e.g., Johnson & Hall, 1988). These authors found that social support is a more important predictor for cardiovascular diseases for women than work control. The argument about “male” model is in line with Kristiansen’s (1995) comment that job strain is another way of measuring social status. There are also a number of different reviews of the models, and the results from them show that the models are capable of predicting health as well as motivational and productivity outcomes (e.g., see Bosma et al., 1997; de Jonge & Kompier, 1997; Hemingway & Marmot, 1998; Kristensen, 1995, 1996; Schnall, Landisbergis, & Baker, 1994; van der Doef & Maes, 1998, 1999; Verhoeven, Maes, Kraaij, & Joekes, 2003). A limitation of the above reviews is that they are mainly based on cross-sectional designed studies. For example, in van der Doef and Maes (1999) review, there were 53 of the 63 studies cross-sectional designs. A cross-sectional design is ill-suited to display the causal relationship between variables because it can’t provide evidence regarding the order of the variables. Therefore a longitudinal design is needed in order to give evidence on the causal order of variables. In a review based on longitudinal studies on the JDCS model de Lange, Taris, Kompier, Houtman, and Bongers (2003) found support for longitudinal causal main effects between psychosocial job conditions included in the JDCS model and health and well-being outcomes (Cook & Campbell, 1979; Taris & Kompier, 2003).

### **Effort-Reward Imbalance**

Effort-Reward Imbalance (ERI) model (Siegrist, 1996, 1998) is an alternative theoretical model, which looks at the reward rather than the control structure of work (Marmot, Siegrist, Theorell, & Feeney, 1999). The ERI model has put its focus on the centrality of paid employment in working life. Effort at work is spent as part of a social contract exchange process, where the society contributes in terms of occupational rewards. Rewards can come in three different ways: money (e.g., adequate salary, pay raise), esteem (e.g., respect and support), and security/career opportunities (e.g., promotion prospects, job security and status). The ERI model anticipates that an imbalance in “cost” and “gain” (i.e., a

condition of high effort and low reward) can cause stress, which can lead to health problems (e.g., cardiovascular risks, sickness absence and poor subjective health). For individuals, who have jobs which are demanding and unstable at the same time, and who are not offered any promotion possibilities, a state of stressful imbalance would be existing.

The ERI model makes an explicit distinction between personal (intrinsic) and situational (extrinsic) components of effort-reward imbalance. A combination of both the personal and the situational components provide a more accurate estimate of experienced stress than a restriction to one of these sources. The situational components consist of efforts (e.g., psychological and physical demands at work) and the three dimensions of occupational rewards (money, esteem, and security/career opportunities). No specification is made of the health effect outcomes of the different types of demands and rewards. It is rather the mismatch between high cost and low gain received which matters most. The term overcommitment is introduced in the personal components, a specific pattern of coping with job demands and of eliciting rewards. This type of coping defines a set of attitudes, behaviours, and emotions, reflecting extreme striving in combination with strong desire of being approved and esteemed. There is evidence that excessive efforts result from perceptual distortion (e.g., underestimation of challenge), which in turn may be triggered by an underlying motivation of experiencing esteem and approval (Siegrist, 1996).

In empirical studies it has been found that high effort and low reward at work is a risk factor for cardiovascular health, subjective health, and mild psychiatric disorders (e.g., Bosma, Peter, Siegrist, & Marmot, 1998; Peter, Alfredsson et al., 1998; Peter, Geißler, & Siegrist, 1998; Peter & Siegrist, 1997; Tsutsumi & Kawakami, 2004; Van Vegchel, de Jonge, Bosma, & Schaufeli, 2005).

### **Transactional process model**

According to the Transactional process model (Lazarus, 1991), stress is a result of an interaction between an individual's characteristics and appraisals. These appraisals may consist of external or internal stressors (e.g., events or environments), and the individual's internal or external resources available to him or her at that moment. Stress is not a belonging of the person, or of the environment. Stress is the result when there is conjunction between person and environment, and only when this transaction is evaluated by the person as harm, threat, or challenge to the well-being of the person. Harm is about damage that has already occurred, as in a loss of employment, failure when applying for work, or disapproval

by management or co-workers. Threat refers to a harm that has not so far happened, but is expected in the future by the person. Stressors that are appraised as challenging are conditions of high demands in which the emphasis is on mastering the demands, overcoming obstacles, and growing and expanding as an individual. In challenge, focus is on the positive outcome and possibilities.

Appraisal is an essential concept in the Transactional process model, and there are two central kinds of appraisals in the model, primary and secondary. An individual's primary appraisal refer to the concerns of whether or not there is any personal stake in the encounter (Lazarus, 1991), and it has been referred to as the motivational relevance part of an encounter (Smith & Lazarus, 1990). Secondary appraisal refers to the accessible options for dealing with harm, threat, or challenge. The assignment of appraisal is to incorporate two sets of forces operating in every adaptational transaction, namely, personal agendas (e.g., goals, beliefs and experiences) brought to the transaction by the individual, and the environmental realities that affect the outcome. Because personal agendas vary between persons, and even within the person from moment to moment, and since the environment is often quite ambiguous and complex, persons attend selectively to what is happening, and evaluate it in different ways. This can result in a great variation in the appraisals individuals make in the same environmental context.

The coping process is a special form of appraisal. Lazarus and Folkman (1984) define coping as the cognitive and behavioural efforts a person makes to manage demands that tax or exceed the individuals resources. Coping shall be seen as a process because the relationship with the environment is constantly changing. Even if stable coping styles do exist and are of importance, the coping process is highly contextual. Effective coping styles have to change over time and across different conditions (Folkman & Lazarus, 1985). The coping patterns also change with age (Lazarus, 1993). Coping has a profound effect on psychological stress and emotional states (Folkman & Lazarus, 1988). Coping is seen as a mediator in the relationship between stress and illness (Carver et al., 1993; Weaver et al., 2004; Wong, 1993). The Transactional process model identifies different coping categories based on the intention, function and meaning of coping efforts. For example, in the original model there is problem-focused and emotion-focused coping (Lazarus & Folkman, 1984), and there is meaning-based coping, introduced by Folkman (1997).

Problem-focused coping refers to cognitive and behavioural efforts used to manage or change the problem, and includes such strategies as gathering information, planning, problem solving, and effort. If this process is successful and alters the person-environment relationship for the better, it will reduce or eliminate the psychological grounds for harm or threat.

Emotion-focused coping refers to strategies, which only try to change the way individuals attend to or interpret what is happening. For instance, a threat that the individual successfully avoid thinking about, even if only temporarily, doesn't bother the individual. Another strategy is reappraisal of a threat into a no threat, meaning that the cognitive basis of the stress reaction is removed. For example, if the employee can reinterpret a negative comment from the supervisor as the unintended result of job stress, the appraisal basis for reactive anger will dissolve. Emotion-focused coping does not change the objective terms of the person-environment relationship, but it changes how these terms are interpreted or attended to. Denial, distancing and positive thinking can at times be useful techniques for controlling psychological stress.

Meaning-based coping is expected to promote personal growth in the midst of chronic stress. For instance, this strategy is the redefinition of personal goals (e.g., stop drinking, in order to manage the job), which may bring a new sense of purpose and direction into the individuals life. It may also help the individual to sustain personal efforts for dealing more efficiently with a stressor.

Coping is central to the stress process and its adaptational outcome. If the individual makes the appraisal that this is an encounter he or she can control or handle with his/her actions, problem-focused coping strategies dominate. Emotion-focused coping predominates if the person judge that nothing can be done to change the situation. Research has shown that coping patterns vary between stressful encounters, and over time (Folkman & Lazarus, 1985; Folkman, Lazarus, Dunkel-Schetter, DeLongis, & Gruen, 1986; Folkman, Lazarus, Gruen, & DeLongis, 1986). Strategies, such as positive thinking are relatively stable across encounters; this strategy is obviously influenced by personality.

Which strategies are good or bad depend on the situation and can vary over time within a situation. For example, denial is widely seen as unhelpful, but can be useful in certain circumstances. If a person experiences symptoms of a heart attack, denial can be dangerous in the sense that it can lead to delay in seeking treatment. The same coping strategy can be successful during recovery from a operation after a heart

attack, but it can become unhelpful again if it continues for too long, so it prevent the person to change lifestyle in order to prevent further attacks.

Research has shown that problem-focused coping is linked to an increase of job satisfaction (Burke, 1998; Rick & Guppy, 1994) and a reduction in anxiety and psychological stress (Grossi, 1999; Hobfoll, Dunahoo, Ben-Porath, & Monnier, 1994). The results of the research on emotion-focused coping give a contradictory picture, some studies show that emotion-focused coping reduces somatic symptoms and psychological stress (Parkes, 1990), and other studies show evidence of increased psychological stress and psychosomatic symptoms (Day & Livingstone, 2001; Smári, Arason, Hafsteinsson, & Ingimarsson, 1997). Another point discussed in research literature is the absence of clarity in the findings of coping's moderating role between different stressors and the outcome (see e.g., Fortes-Ferreira, Peiró, González-Morales, & Martin, 2006). There are some studies supporting this moderating effect (Day & Livingstone, 2001; Eriksen & Ursin, 1999). A second group have show weak support for the moderating effect (Bhagat, Allie, & Ford, 1995; Greenglass, Burke, & Ondrack, 1990), whereas a third group cannot establish any support (Leiter, 1991; Rick & Guppy, 1994).

The Transactional Process model has been criticized by Brief and George (1991) because it focuses too much on the individual employee. They point out that it is just as important to identify stressful conditions at work that have an effect on groups of employees. Other researchers (Carver, Scheier, & Weintraub, 1989; Dewe, Cox, & Ferguson, 1993) have argued that coping strategies should not be combined into broad categories, but regarded separately.

### **Summary of the occupational stress theories**

These conceptual stress models are the foundation for JSS from an occupational perspective. The P-E fit model has been increasingly criticized for lacking in specificity and failing to identify and quantify the specific sources of stress put on the employees in the workplace (Chemers et al., 1985; Edwards & Cooper, 1990; Fletcher & Jones, 1993). These limitations have given rise to the development of models that incorporated, expanded, and modified the concepts of P-E fit theory. Like the P-E fit model, the JDCS and the ERI models focus on the interaction of general demands of work, and the skills and characteristics of the employees. This models give less attention to how specific job pressure influences health and productivity. There are overlapping features in these two models, and both models integrate psychological and sociological theories to conceptualize and analyse relationships between psychosocial

factors and health outcomes (Rydstedt, Devereux, & Sverke, 2007). The JDACS model primarily focuses on the work content and implies that job task control is critical for understanding job strain, whereas the ERI model is focused on the wider concept of reciprocity and fairness in the social exchange process (Marmot et al., 1999; Siegrist, 1996). In the ERI model subjective meaning of work experience is taken into account in the work process through inclusion of individual characteristics (Calnan, Wainwright, & Almond, 2000). The ERI and JDACS models contribute with different but related types of information and aspects of the relationship between the psychosocial work environment and health, and the two models with their different features should be seen as complementary to each other (Siegrist & Marmot, 2004). Rydstedt and colleagues found that combining the two models will slightly increase the explanatory power for predicting work-related mental strain (Rydstedt et al., 2007).

There is a distinction between Karasek's JDACS model and Lazarus Transactional Process Model in that JDACS asserts that the primary source of work stress lies not within the individual, but in the characteristics of the work environment. In the Transactional Process model stress is seen as the result of the interaction between person and environment, and only if the individual sees this transaction as a threat, the well-being of the person is harmed or challenged. Lazarus' conception of occupational stress and theories concerning Person-Environment fit have both merits and limitations, and can be seen as complimentary rather than contradictory in providing a meaningful conceptual framework for understanding occupational stress (Spielberger & Reheiser, 1994b). The major differences between the two perspectives are that the Person-Environment fit theories identify general conditions that produce strain at work (e.g., demands), whereas the Transactional Process model focuses on a particular event and how the employee perceives and appraises this event.

### **Sources of occupational stress**

To assess the consequences of stress in the workplace, we have to understand the occupational sources of stress. Cooper (1986) has differentiated six groups of primary work-related stressors: Factors intrinsic, organizational roles, work relationships, career development, organizational factors, and the home-work interface. These six categories are not exhaustive descriptions of all potential stressors within each category, but shall be seen as a useful framework for identifying physical and psychosocial sources of job-related strain.

### **Factors intrinsic**

Intrinsic work factors may have a serious negative impact on workers' physical health and psychological well-being (Cooper, 1987). There are a number of factors that may be intrinsic to the job. Examples are poor working conditions, such as lighting, noise, and smells (van Kempen et al., 2002), work hours (De Raeve, Jansen, & Kant, 2007; Sparks, Cooper, Fried, & Shirom, 1997), risk and danger, new technology (Cartwright & Cooper, 1997; Korunka, Weiss, Huemer, & Karetta, 1995), work overload (Warr, 1994; Westman & Eden, 1992), and work underload (Melamed, Benavi, Luz, & Green, 1995).

### **Organizational roles**

This category consists of three major aspects of organizational roles which may be sources of stress: role ambiguity, role conflict and responsibility. A wide range of events can create role ambiguity (Beehr, 1995). These events can be summarized in three types of role ambiguity, lack of clarity about scope and responsibilities of job, lack of clarity of objectives for role, and inadequate information about work role. The stress indicators found to relate to role ambiguity are low job satisfaction, physiological strain, intentions to leave job, low self-confidence, low motivation to work, and depression (e.g., O'Driscoll & Beehr, 1994). Role conflicts exist when an employee is divided by conflicting job demands, or required to perform tasks disliked, or outside of the job description. Role conflicts can be manifested in different ways: (1) between an individual's internal standards and required job behaviors; (2) between time, resources, or capabilities of an individual; (3) because of conflicting expectations and organizational demands; and (4) between multiple roles for the same person which require incompatible behaviour (Quick & Quick, 1984). Role conflicts can lead to decline in job satisfaction and increased anxiety levels (e.g., Nystedt, Sjöberg, & Hägglund, 1999). The connection between role conflict and psychological stress is not as strong as that between role ambiguity and psychological stress (Jackson & Schuler, 1985).

There are two types of responsibility in an organisation, responsibility for people, and responsibility for things (e.g., equipment, buildings). Responsibility for people has been found to be particularly stressful. Being responsible for people often requires spending more time interacting with others, more meetings and meeting deadlines. The interpersonal relationships at work with superiors, peers, and subordinates can be a major source of both stress and support (Makin, Cooper, & Cox, 1996).

### **Work relationships**

Interpersonal relationships and lack of social support from others in the workplace can be seen as a potential source of job-related stress. There is a clear connection between negative interpersonal relations and the absence of social support from within the workplace (Narayanan, Menon, & Spector, 1999). Lack of support from supervisors is a major source of stress at work (Cooper, Dewe, & Driscoll, 2001). Moyle (1998) has shown that lack of support predicts lack of job satisfaction and mental health. On the other hand, feelings of social support from colleagues and supervisors may reduce psychological stress (Karasek & Theorell, 1990). Leadership style is a potential source of stress at work for the employees. For example, a leadership style which is task-oriented on the expense of relationships and does not consider the needs, attitudes, and motivation of the employees has been shown to create stress (O'Driscoll & Beehr, 1994).

### **Career development**

Throughout the working life of the employee different factors act as stressful. Examples are lack of job security, fear of redundancy, retirement, and frustration of having reached one's career ceiling. Globalization of the labour market, downsizing new technologies, reduction of levels of management are factors which can be potential threats to the individual employee and lead to feelings of job insecurity. Job insecurity may be one of the most salient sources of strain for employees, and it will affect all levels of the organization.

### **Organizational factors**

Psychological strain attributed to organizational factors is often due to the culture and management style adopted within an organization (Cooper & Cartwright, 1994). Hierarchical, bureaucratic organizational structures may lead to lack of employee participation in decision-making processes, which can create a sense of no belonging and lack of job satisfaction in the organization. Inadequate communication, especially between supervisor and employees, may result in stress (Cooper et al., 2001).

### **Home-work interface**

Managing the interface between work and various roles and responsibilities outside of work is another potential source of stress (O'Driscoll, 1996). Changes in family structures, increased participation by women in the workforce, and changes through technological development, for example, usage of mobile phones and portable

computers enable job tasks to be performed in locations outside the office. Together these changes have blurred the boundaries between work and life outside of work for many workers, leading to a potential risk for a conflict to emerge between home and work (Hill, Miller, Weiner, & Colihan, 1998).

Number of work hours is related to added risk of work-family conflicts, decline in mental and physical health, and decreased family functioning (Major, Klein, & Ehrhart, 2002). Mauno and Kinnunen (1999) found that job pressure is negatively related to marital satisfaction. Results from studies on work-family conflicts show that men had less difficulty in combining work responsibilities and family relations than women (Scott, 2001), and working fathers reported lower levels of work-family conflict than working mothers (Hill, Martinson, Hawkins, & Ferris, 2003). Parasuraman and Greenhaus (2002) stated that there are relatively few studies which specifically have focused on work-family and gender, and this represents a critical gap in work-family research.

### **Occupational stress and health**

The effects of occupational stress on employees' health and well-being have been evaluated by several cross-sectional and longitudinal studies which have shown that the combination of high demands and low control at work is associated with psychological distress and health complaints (e.g., Bourbonnais, Comeau, & Vezina, 1999; Cheng, Kawachi, Coakley, Schwartz, & Colditz, 2000; de Jonge, Bosma, Peter, & Siegrist, 2000). Other studies reports that low control at work is especially important (e.g., Elsass & Veiga, 1997; Stansfeld, Bosma, Hemingway, & Marmot, 1998). Musculoskeletal disorders are another major problem in work and in modern society, in spite of the ergonomic enhancements which have been made at the workplace (Johansson, 1994). Musculoskeletal disorders in neck, shoulder and back is the most usual type of occupational disease in Sweden and in other countries (Kilbom et al., 1996). It is well known that unfavourable psychosocial work conditions add to the risk of musculoskeletal disorders (Ariëns et al., 2001; Bongers, Kremer, & ter Laak, 2002; Bongers, Winter, & Kompier, 1993; Hoogendoorn et al., 2000; Kjellberg & Wadman, 2007; Linton, 2001). Work-related musculoskeletal disorders are not tied to a certain type of work. These disorders affect workers in a wide variety of occupations, and they usually take months or even years to develop (Hagberg et al., 1995). Because of lack of standardized assessment criteria, estimations of the costs for work-related musculoskeletal disorders are limited.

In a number of studies, social support has been found to be protective against negative health outcomes, such as pain in neck and shoulder (Ariëns et al., 2001; Bongers, Ijmker, van den Heuvel, & Blatter, 2006; Larsson et al., 2007), back pain (e.g., Clays et al., 2007; Hartvigsen, Lings, Leboeuf-Yde, & Bakketeig, 2004; Hoogendoorn et al., 2000), or musculoskeletal problems in general (e.g., Woods, 2005). Social support at work was one of the factors that predicted absenteeism from work among patients with chronic musculoskeletal pain (Marhold, Linton, & Melin, 2002). For individual who already have problems with musculoskeletal pain, access to social support was important in coping with symptoms and related positively to health (Krause, Lynch et al., 1997). There are different types of social support, and Grahn, Stigmar and Ekdahl (1999) found in their study that social support at work was the most vital type of support when helping with motivation for behavioural changes in patients with long-standing musculoskeletal disorders.

Davis and Heaney (2000) state that the mechanisms for how social support induces musculoskeletal ill-health remain undefined. One explanation for this can be that most studies use computed scales when reporting the results, presumably leading to the loss of more profound information on the contribution of different components of social support linking to health (Woods, 2005). Another explanation can be defined in definition of social support and how we group and categorize social support variables. There are some differences in how different researchers group components of social support, and Woods (2005) uses six different categories: (1) General social support, including support from supervisor, co-workers and general acceptance by peers; (2) Good communication, as, for example, ability to communicate with supervisor and co-workers; (3) Satisfactory relationships at work, for example, satisfaction with colleagues and work atmosphere; (4) Understanding of pain, that is, supervisors and co-workers support of pain; (5) Help from supervisors and co-workers when things are difficult; (6) Social support away from work. Cohen (2004) presents another categorization where he defines social support as intention to benefit an individual's ability to cope with stress, and makes a distinction based on mechanisms between (1) Social support (stress buffering); (2) Social integration (promotes positive states); (3) Negative interactions (relationships as a source of stress). Cohen states that these variables are associated with health outcomes, and that they influence health through different mechanisms.

A wide range of occupational factors in the workplace can influence the occurrence and severity of musculoskeletal disorders (Punnett & Gold, 2003; van Dieën, Visser, & Hermans, 2003). The different factors can be

classified into two main categories, ergonomic (biophysical) and psychosocial factors (Blair et al., 2003), and there is a variety of job factors that affects the risk for developing musculoskeletal disorders. Ergonomic factors are high intensity of muscular contractions, time constraints (e.g., high work rates, high frequency of mechanical loading), repetitive and stereotyped work position or movements, static loading of long duration, high precision movements of low intensity, and vibration. Psychosocial factors, for example, are skill under-utilization, lack of control, lack of support, unpleasant physical work conditions, and harassment or bullying.

Recent reviews have shown that there is a relationship between psychosocial factors at work (e.g., low job control and lack of support, high job demands and workload) and musculoskeletal symptoms (see e.g., Ariëns et al., 2001; Bongers et al., 1993; Hoogendoorn et al., 2000). Nonetheless, the results are ambiguous and somewhat contradictory, and the roles of the psychosocial factors in the development of the musculoskeletal disorders are not yet clearly understood. Punnett and Gold (2003) states that the relationship between musculoskeletal disorders and psychosocial factors at work cannot be represented by a simple exposure-response relationship, since these features at work often interact with one another and also cause multiple types of musculoskeletal disorders, even in the same work settings. They state that the multifactorial nature of these relationships is sometimes misunderstood or misinterpreted as a lack of scientific assurance that a cause and effect relationship exists.

The ergonomic factors can act as stressors which can generate musculoskeletal disorders through a number of pathophysiological mechanisms (Blair et al., 2003), and the psychosocial factors have an emotional value for the worker, which can influence the workers subjective well-being in different ways (Hagberg et al., 1995). There are different physiological explanatory models addressing the issue of how work-related psychosocial factors can affect the development of musculoskeletal disorders (Blair et al., 2003; Melin & Wigaeus Törnqvist, 2005). The Johansson and Sojka model (Johansson & Sojka, 1991) and the Cinderella hypothesis (Hägg, 1991) are two of these models, in both of this models the psychological stress effect on the mechanism are recognized (Blair et al., 2003; Lundberg et al., 2002; Melin & Wigaeus Törnqvist, 2005). But neither of the models is formulated in a way which makes it easy to apply psychological self-rated data.

The Johansson and Sojka (1991) model relates to the finding that the number of muscle spindles is high in the neck and shoulder region. The muscle-spindle system is important for coordination of movements,

allocation of muscle activity, and for regulation of muscle stiffness. This model assumes that long-time static or repetitive work causes dysfunctions in the muscle-spindle system, which will increase the activity in the system, which in turn increases the muscle stiffness and the production of metabolites. Thus a positive feedback loop or “vicious circle” is generated, where increased muscle stiffness may cause higher concentrations of inflammatory substances (e.g., bradykinin, serotonin). This continues the vicious circle by signalling back to the muscle spindles, which becomes even more active. Increased activity influence the muscle spindles regulation, which may cause dysfunctional coordination and inadequate muscle activity. Such vicious circles can spread to other muscles than the initial one, this distinguishes the Johansson and Sojka model from the Cinderella hypothesis. The sympathetic nervous system (SNS) plays an important role in the Johansson and Sojka model, as the SNS is involved in vascular changes and changes in muscle contractility, in modulation of afferent information from muscle spindles, and in metabolic changes at cellular level (Passatore & Roatta, 2003). Thus, physical as well as psychological stress is a main factor in the vicious circle process.

The Johansson and Sojka (1991) model has received support (e.g., Djupsjöbacka, Johansson, Bergenheim, & Sjölander, 1995; Djupsjöbacka, Johansson, Bergenheim, & Wenngren, 1995; Pedersen, Sjölander, Wenngren, & Johansson, 1997; Wenngren, Pedersen, Sjölander, Bergenheim, & Johansson, 1998). One problem, though, is that most of the support for this model comes from animal studies, and the model needs more verification in human subjects (Knutson, 2000).

The Cinderella hypothesis is an analogy of the fairy tale with the same name. Cinderella was the first to rise and the last to go to bed and was thus likely to be fatigued in the long run. The Cinderella hypothesis suggests that work-related myalgia is caused by overloading of low-threshold motor units. During repeated or static load the small and sensitive motor units are the first units activated in a muscle contraction and they are also the ones which are the last to shut down when the contraction is ended. These motor units are active as long as the muscle is at work, and are only at rest during complete relaxation. These motor units are therefore vulnerable to fatigue due to overload, which in the long run can lead to metabolic disturbances and damaged muscle fibres.

According to the Cinderella hypothesis the muscle pain is due to insufficient recovery, and findings in different studies support the association between lack of muscle rest and myalgia in the trapezius (e.g., Hägg & Åström, 1997; Sandsjö, Melin, Rissén, Dohms, & Lundberg, 2000; Sjøgaard, Lundberg, & Kadefors, 2000). Psychosocial factors are

suggested to keep motor units active, and Lundberg et al. (2002) have found that some motor units which are active during physical activity are also active during mentally encouraged muscle activity. In work which demand low overall muscle activity, signals of fatigue are too weak to be detected and the individual may continue working without knowing that some motor units are overloaded. When the muscle exposed for static load, the concentration of inflammatory substances and metabolites are increased in the muscle, due to reduced blood flow, which results in an increase in pain sensitivity (Lundberg et al., 2002). Psychologically perceived stress is often more persistent than physical demands, which indicates that psychological stressors are important contributors to fatigue and overuse of motor units, even in the absence of physical demands, as, for example, during breaks at work and outside of work.

### **Cross-cultural perspective on occupational stress**

In a historical perspective, much of the research on occupational stress has been performed in North America and Great Britain. More recently important work is coming also from Northern and Western Europe (Glazer & Beehr, 2005). However, it is unclear if the results and conclusions drawn from studies in Western societies are generalizable to non-western societies, such as China (Liu, Spector, & Shi, 2007). Cross-cultural studies of psychosocial and health factors are important, because such studies provide better understanding of variations of stress variables and provide better opportunities for testing and evaluating theories and instruments in different contexts (Marmot & Madge, 1987).

Results from cross-cultural studies show some evidence that similar stress concepts may exist in different countries. Investigations of role conflict, role ambiguity, and role overload in 21 countries showed that the constructs and measures were valid with minor modifications (Peterson & Smith, 1997). Liu and colleagues (Liu et al., 2007) found that lack of job control was a frequently reported stressor by employees in USA but not in China, which were in line with their belief that Americans would expect and experience more control. They found no difference between university employees in China and USA in overall interpersonal conflicts, but Americans reported more direct conflicts, whereas Chinese conflicts were more indirect. The researchers concluded that this deviation came from the cultural differences (individualism vs. collectivism). Spector et al. (2004) found that managers in Anglo countries (Australia, Canada, England, New Zealand and USA) reported more pressure in the work-family interaction stressor, which was interpreted as a result of the longer

work hours for managers in Anglo countries than their counterparts in China and Latin America.

Verhoeven et al. (2003) states that results from studies on job demands, job control, and social support from colleagues and supervisors may not be similar in different cultures and countries. A Polish study by Makowska (1995) found no relationship between the JDCS model and health. Along the same line a study of blue-collar workers in Japan showed no relationship between the model and depressive symptoms (Kawakami, Haratani, & Araki, 1992). Kushnir and Melam (1991) found in their study on Israeli industrial workers support for the buffer hypothesis, but no support for the strain hypothesis of the model in relation to somatic complaints. The failure to confirm the JDCS model in these studies may also be explained by other factors, but these results raise questions concerning the validity of the JDCS model in different cultural contexts. The JDCS model was created in north-western Europe and the United States, and most of the studies using the JDCS model have been carried out in that part of the world. One question which can be raised is thus whether the model is capable of exploring relationships among work conditions and health outcomes in countries and cultures outside north-western Europe and United States (Verhoeven et al., 2003).

### **Gender, stress and health**

In general women report more stress (Narayanan et al., 1999; Nolan-Hoeksema, 1990; Spielberger & Reheiser, 1994a; Spielberger & Vagg, 1999; Vagg, Spielberger, & Wasala, 2002). Women reports pain more frequently (Eriksen, Ihlebæk, & Ursin, 1999; Eriksen, Svendsrød, Ursin, & Ursin, 1998; Ihlebæk, Eriksen, & Ursin, 2002). Musculoskeletal complaints are more commonly reported by women in both general populations (Hooftman, van der Beek, Bongers, & van Mechelen, 2005; Leino-Arjas, Hänninen, & Puska, 1998; Linton, Hellsing, & Halldén, 1998) and in working populations (Gerr et al., 2002; Krause, Ragland, Greiner, Syme, & Fisher, 1997). One explanation of these gender differences could be less autonomy and fewer opportunities for modifications of women jobs (Leino & Hanninen, 1995; Nordander et al., 1999; Zetterberg et al., 1997). Another explanation is that women react more powerfully than men to psychological stressors such as interpersonal conflicts or deadline pressures at work (Treaster & Burr, 2004).

Psychosocial variables might be more contributing to musculoskeletal disorders for women than for men, particularly to disorders in the neck and shoulder region (Ariëns et al., 2001; Hooftman et al., 2005). One

predominant reason for this is that women work is more stressful for this actual region than what men work is. Women work may generally be perceived as being less demanding because it does not include forceful exertion. It is more often characterized by a high static loading on the neck and shoulder area. The work is often requiring fast paces, precision, and recurrence for small muscles (Punnett & Herbert, 2000).

There are studies that report that men and women differ in the uses of coping strategies. Men use more often problem-focused coping strategies (Folkman & Lazarus, 1980; Hurst & Hurst, 1997), whereas women use emotion-focused coping strategies (Hurst & Hurst, 1997; Tamres, Janicki, & Helgeson, 2002). These differences in the use of coping strategies disappear when occupation, education and position are controlled for (Greenglass, 2002). This conclusion is supported by the Long and Kahn (1993) findings that differences in use of coping strategies come from results which are based on studies in which men and women are not matched on occupation.

## METHOD

### Design

The studies in this thesis are exclusively based on self-ratings, and in the questionnaires used, the subjective perspective of the participants was asked for. In evaluation of JSS, cross-sectional designs were used (Study I and II). In Study III the purpose was to examine the relationship between work-related stress and musculoskeletal problems, and because a cross-sectional design is ill-suited to display causal relationships, a longitudinal design was applied.

### Participants

Study I and Study II uses the same sample of participants for evaluation of different aspects of JSS. Managers and representatives of labour unions in metal industry and medical service units in northern parts of Sweden were contacted and given the opportunity to participate in the work stress project. Metal industry data came from eight different companies, varying in size from around 50 employees to more than 1000 employees. In the larger companies, only some of the departments of the companies participated in the study. In the medical service sector, data were collected from a university hospital and from health care centres, in several communities. The university hospital data, as well as the data from health care centres covered a representative selection of units and departments, including units for administration and maintenance. A total number of 1186 employees participated, which gives a response rate of 79.0 % for the sample. The age of the employees varied between 17.5 and 64.9 years (M age = 43.1, SD = 11.1), the gender breakdown being 51.3 % men.

To evaluate the concurrent validity of the JSS instrument in Study I, an additional sample of participants was used. These participants were 32 ambulance personnel, 29 men and three women, varying in age between 29.2 years and 58.1 years (M age = 40.6; SD = 8.31).

In Study III two of the metal industry factories participated in a four wave longitudinal data collection, with the first in November 2001, the second six month later, and then every 12 month. All workers from both factories were asked to participate in the study. Table 1 presents employee characteristics for the two factories over the four waves of data collection, and for the employees who has participated in all four measurement waves (T1-T4).

**Table 1**

*Characteristics of Participating Employees in Factories A and B in each Measurement Occasion, and of Employees Participating in all Four Measurements (T1-T4)*

	F	n	tot	M	W	Age range	M age	SD
T1	A	54	73	51	3	19.1-63.6	37.3	11.89
	B	61	70	52	9	20.5-61.6	39.3	9.55
T2	A	59	77	54	5	19.5-64.0	39.1	11.78
	B	57	73	49	8	20.9-58.1	37.8	9.83
T3	A	53	70	48	5	20.8-59.9	38.5	10.51
	B	58	70	52	6	22.0-63.1	40.4	9.76
T4	A	47	60	44	3	22.6-60.9	41.6	10.82
	B	56	70	47	9	19.7-60.2	40.9	10.03
T1-T4	A	27		26	1	20.2-55.9	39.1	10.30
	B	29		24	5	23.9-56.1	38.4	9.35

Note. F=factory; n=Total number of participants; tot=Total number of employees; M = men; W = women; M age = mean age (Study III, Holmström et al., 2008).

### **Data collection procedure**

Data collections were conducted during working hours in the work place. The participants were informed about the purpose of the study and informed consent was obtained. Instructions were given about how to use the scales of the survey, and there were several practice trials. If someone wished to get help to understand the meaning of items, or wanted further help about the rating procedure the test administrator provided such help. Total time for instructions and completing the survey was approximately one hour. After one to two months feedback was given to the work place and results were presented on group level and discussed with managers and employees.

### **Measures**

#### **Job Stress Survey**

The JSS instrument consists of 30 items that express different job-related stressor events (Spielberger, 1991; Spielberger & Vagg, 1999). The instrument is divided in a severity part and in a frequency part. In the first part the participants first rate the perceived severity of each stressor event on a nine-point scale, ranging from 1 (low stress) to 9 (high stress). Every stressor is to be compared with the stressor "Assignment of disagreeable

duties”, serving as a standard stressor and placed at the midpoint of the scale (i.e., 5, moderate stress). For example, when the respondent is rating a stressor like “Poor or inadequate supervision”, the respondent is supposed to compare it against the standard stressor “Assignment of disagreeable duties”. Severity ratings greater than, and less than 5 indicate that “Poor or inadequate supervision” is considered by the respondent to be more or less stressful than the standard. In previous research, this standard has consistently been given an average rating by workers in a variety of occupations (Grier, 1982; Spielberger et al., 1981). When completing the first part, the respondent reports in the second part how often (in days) each stressor occurred during the last 6 months, using a 10-point scale from 0 to 9 or more.

The JSS instrument comprises three stress scales and six subscales. The stress scales are named Job Stress Severity (JS-S), Job Stress Frequency (JS-F), and Job Stress Index (JS-X). The JS-S scale shows the respondent’s average rating of perceived severity of the 30 JSS stressor events. The JS-F scale indicates the average frequency of occurrence of the 30 JSS stressor events for the period of the last six months. The JS-X is the overall stress scale for level of occupational stress. In the JS-X scale the severity and the frequency ratings are combined into an overall indicator of perceived stress (severity x frequency). By selecting only some of the 30 items, six subscales can be created: Job Pressure (JP-F, JP-S, and JP-X) and Lack of Organizational Support (LS-F, LS-F, and LS-X). Job Pressure consists of the ten items which are attributed most directly to pressure of work, such as “meeting deadlines”, “working overtime” and “dealing with crisis situations”. Items reflect aspects of the job’s structure, design or duties. Lack of Organizational Support involves ten items which reflect events involving other people (co-workers and supervisors) or organizational policies and procedures, rather than specific aspects of the job itself. Items included are “fellow workers not doing their job”, “inadequate support by supervisor”, and “inadequate/poor quality equipment”.

### **Perceived Stress Questionnaire (PSQ)**

A Swedish version of PSQ (Bergdahl & Bergdahl, 2002) was used to examine the concurrent validity of the JSS instrument. The PSQ measure perceived stress by focusing on cognitive aspects more than emotional states or specific life events (Levenstein et al., 1993). PSQ consists of 30 items, and items are scored from 1 to 4 (i.e., 1. Almost never; 2. Sometimes; 3. Often; 4. Usually). The PSQ index is acquired through computing the total raw score, using the formula (raw score-30)/90, and varies from 0 (lowest level of perceived stress) to 1 (highest level of

perceived stress). Bergdahl and Bergdahl (2002) reported good concurrent validity for the Swedish version of the instrument.

### **Self-rated health**

The subjective health questionnaire consists of 28 items. When responding to the health items a five-point scale, ranging from 4 (Yes, absolute) to 0 (No, absolutely not) were used. The measure of subjective health was done in two ways: First, participants assessed whether they currently felt healthy. Second, on the remaining 27 items participants were asked to estimate if they had experienced symptoms categorized as being of psychiatric nature (e.g., worry, feeling of loneliness, difficulties in sleeping), and if they had experienced symptoms of somatic nature (e.g., neck pain, stomach pain).

The questionnaire is the same subjective health questionnaire as used in the Betula Study (Nilsson et al., 2004; Nilsson et al., 1997). The Betula Study started in 1988, and is a longitudinal study with the aim of exploring cognitive functions and health in adulthood. Four waves of data collection have been completed in 5-year intervals since the start of the project. The purpose for using the same questionnaire as in the Betula Study is that the results from the Betula Study can be used as norms for the questionnaire.

### **Statistics**

Latent constructs such as stress give the researcher a delicate measurement problem, as it is not always possible to observe the perceived stress of an individual. Another problem is that there are many different definitions and theories existing which describe the stress construct. There are several theories that approximately describe the same psychological construct, for example, theories directed at the interaction between person and environment.

The empirical studies in this thesis are concerned with construct validation of the JSS in one form or another. Factor analysis is one of the most frequently used methods for evaluating construct validation (Nunnally & Bernstein, 1994). Factor analysis describes a set of related techniques rather than a single method, and factor analysis is a technique with a long tradition in measurement theory. The goal of the factor analysis is to find factors that explain covariation among different variables and to illustrate how a small number of latent constructs (e.g., items that measure stress) can explain covariation among larger numbers of measured variables, such as behaviour ratings, scores on test items, or subtest scores

(Tinsley & Tinsley, 1987). Factor analysis can be divided into two classes, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Stevens (2002) clarifies the differences between EFA and CFA by stating that EFA is used to identify the factor structure for a set of variables, and to determine how many factors exist, as well as the pattern of the factor loadings. CFA, on the other hand, is a theory-testing procedure, which allows the researcher to specify the factor model in advance and define which variables will load on which factors. In this thesis exploratory factor analyses were used, the emphasis here is on replication, and on examining if the same factor structure will unfold in the Swedish version as in the original version of the JSS. The benefit with EFA is the possibility to detect items with cross-loadings on more than one factor. Items with cross-loadings on several factors are inaccurate and noisy and a threat to the validity of the instrument (Rick et al., 2001).

Item bias is a major threat to the fairness and measurement validity of the instrument (Kristjansson, Aylesworth, McDowell, & Zumbo, 2005). Description of item functioning is a relatively modern psychometric development (Nunnally & Bernstein, 1994), and analysis of item functioning is of importance when evaluating construct validity (Cole, 1999; Dean, Holst, Kreiner, Schoenborn, & Wilson, 1994; Zumbo, 1999). Measurement instruments with a high degree of differential item functioning (DIF) may not assess what it is intended to assess and a sign of low construct validity (Kristensen, Bjorner, Christensen, & Borg, 2004). In traditional psychometric methods for validation of items from multi-item scales (e.g., Cronbach's alpha, factor analysis, and inter-item correlations), focus is on evaluating how well each item assesses the concept that is related to the instrument (Petersen et al., 2003). One way to do this is by calculating the internal consistency level which describes the relationship between items in scale and subscale, respectively. An acceptable Cronbach's alpha (internal consistency) does not exclude the possibility of severe item bias, because the Cronbach's alpha does not consider exogenous variables such as e.g., gender, age or occupation (Groenvold, Bjorner, Klee, & Kreiner, 1995). According to Groenvold et al. (1995) this emphasizes the point that traditional psychometric tests like Cronbach's alpha, factor analysis, and inter-item correlations fail to take analytic purposes on an index into account. Cronbach's alpha is calculated in a context that is detached from the clinical problem investigated. Therefore, it is of limited interest if the internal consistency is excellent, if the index is severely biased in relation to a subgroup used for grouping in the analyses. This is an interesting aspect which extends the model of construct validation to include the intentional use of the instrument.

Statements like “this instrument is known to have good validity and reliability” lose their meaning, because the instrument performed well in another population or with other research questions, and does not exclude the possibility that the use of this instrument in new contexts will result in severe information bias. This knowledge is not new (Nunnally & Bernstein, 1994), but so far not applied in the traditional procedures used for construct validation in work stress research.

### **Exploratory factor analysis**

The idea of EFA is to find meaningful relations between items, or meaningful clusters of items, usually called factors. Factor analysis is a rather subjective enterprise. In both EFA and CFA there are a number of different choices for the researcher to make, and these choices can have a big influence on the outcome of the analysis (Nunnally & Bernstein, 1994). For example, the researcher has to choose which method that should be used, the number of factors extracted, if the factors should be rotated, and last, but not least, interpret the results in terms of meaning. The number of factors to be retained is a critical decision in EFA, and there are several decision rules here (see e.g., Glorfeld, 1995, for a review). The minimum criterion is that factors with eigenvalue greater than one are extracted (Kaiser, 1960). Since this method has a tendency to extract too many factors, Cattells (1966) scree test method is often used as a diagnostic tool. Both of these methods have advantages, but perhaps the most useful decision rule is to extract the number of factors that produce the solution that makes the best theoretical sense, provided that other statistical decision rules have been taken into account.

The question of rotation of extracted factors is another essential part of the EFA process. There are two different rotation techniques, those which assume that factors are uncorrelated (orthogonal rotational techniques) and those which allow factors to correlate (oblique rotational techniques). In Study I the factors are highly correlated, and therefore an oblique promax rotation was used.

### **Differential item functioning**

There are several methods existing for evaluation and identification of Differential item functioning (DIF, c.f. Kristjansson et al., 2005). In the present study ordinal logistic regression is used to evaluate DIF in JSS items. A reason for selecting this method was that it is considered to be more general and flexible than the other DIF procedures (Swaminathan & Rogers, 1990). Furthermore, ordinal logistic regression is a suitable

method for detecting DIF in ordinal items (Kristjansson et al., 2005). DIF is based on the ordinal logistic regression equation

$$y = b_0 + b_1 \text{TOTAL} + b_2 \text{GRP} + b_3 \text{TOTAL} \times \text{GRP}_i + \varepsilon_i$$

Zumbo's (1999) DIF concept measures the effects of group and the interaction over and above the total scale score. The test for statistical significance follows a hierarchy of steps for entering variables into the model. In the first step the total score variable is entered, at the second step, the grouping variable (e.g., gender) is included. In the last step, the interaction term between the variables included in the first and second stage entered. The last step in the analysis describes whether the difference between the group responses on an item changes over the latent variable continuum.

With the results from the chi-squared test for logistic regression from the first and third step, one can calculate the significant level through subtracting the chi-squared value in step three from the value in the first step. The differences in chi-squared value can then be compared to its distribution function with 2 degrees of freedom ( $3 - 1 = 2$  df). To calculate the R-squared level, the same procedure is used as for chi-squared calculation.

For an item to be classified as displaying DIF, two criteria must be met: First, the chi-squared must have a p value less or equal to .01. Secondly, the effect size measure must have an R-squared value of at least .035. In my thesis I use the effect-size criteria suggested by Jodoin & Gierl (2001) to quantify the magnitude of DIF, that is, DIF is negligible for effect-size values below .035, moderate for levels between .035 and .070, and large for levels above .070.

## SUMMARY OF STUDIES

This section briefly summarizes the results from the three empirical papers that constitute the basis of this thesis. The first study assesses and evaluates the psychometric properties of a Swedish version of the Job Stress Survey (JSS). The second study examines JSS with special attention to the problems of differential item functioning on subgroups of gender and occupation. In the third study a longitudinal design were used in order to study the relationship between workplace stress and health over a four-year period, another purpose with the third study were to investigate the ability of JSS to relate to health, especially musculoskeletal problems.

### Study I

Holmström S., Molander, B., Jansson, J., & Barnekow-Bergkvist, M. (2008). Evaluation of a Swedish version of Job Stress Survey. *Scandinavian Journal of Psychology*, 49, 277-286.

The main purpose of the present study was to evaluate a Swedish version of JSS (Spielberger & Vagg, 1999). In particular, we focused on the psychometric properties of the instrument and to what extent it would be possible to verify the original factor structure in this version. There are relatively little published data on the psychometric properties of the JSS, which makes it hard to fully assess the strength of the instrument (Rick et al., 2001). However, the work that has been published so far is promising. It is important to make a careful and thorough evaluation of the original instrument to find out how it works in different settings and in various occupational groups. An important part of the process of establishing cross-cultural construct validity is to calculate and evaluate the psychometric properties of the adaptations of the instrument in various countries.

In this study 1186 employees participated, working in metal assembly industry and in medical service in northern Sweden. The age of the employees varied between 17.5 and 64.9 years (M age = 43.1, SD = 11.1), the gender distribution were 51.3 % men, and the response rate for the whole sample was 79.0 %. The stress in this study was laid on replication rather than theory testing, and therefore exploratory factor analyses were used to identify the underlying factor structure of the JSS.

The initial analysis indicated that a five-factor model was best for describing the item intercorrelations in the Severity scale. A scree plot analysis showed that a two-factor model was the best solution, with the subscales Lack of Organizational Support and Job Pressure. This model is

in line with the findings reported by Spielberger and Vagg (1999), who found two strong factors and two or three weaker factors for both men and women. The same factor structure was found for both the Frequency and Index scales.

There are some differences between men and women in the Severity scale with respect to how items load on the different factors. There are four items that have different loading patterns for men and women. Interestingly, for men, the four items load on the same factors as in the original instrument, whereas for women these items load on the opposite factors. In the American version there was a difference in loading pattern between men and women too, but if this difference is a real gender difference in JSS, an effect of difference in work setting (e.g., duties, responsibilities, organizational level), or due to cultural differences is hard to assess.

Occupational level seems to have a stronger impact on job stress than gender (Vagg & Spielberger, 1998), because the interaction with organizational level influences the reaction of men and women to different sources of stress (Vagg et al., 2002). To evaluate gender differences in JSS, further analysis on item level is therefore needed.

The results also showed that the same factor structure was found to be stable for both the metal industry and the medical sectors in the analyses of the Severity, Frequency, and Index scales. When metal assembly workers and medical service workers were tested separately, the same two subscales, Job Pressure and Lack of Organizational Support, were found in the Severity, Frequency, and Index scales.

Furthermore, the results from the factor analyses showed a good fit between the Swedish version and the American version with item loadings over .4, or greater, on both subfactors in all three scales (Severity, Frequency, and Index). These results confirm previous analyses of the factor structure (Spielberger, 1991; Spielberger & Reheiser, 1994a; Spielberger, Reheiser, Reheiser, & Vagg, 2000; Vagg & Spielberger, 1998). Analyses of the internal consistencies of the different scales revealed alpha levels between .84 and .95, which are above Nunnally and Bersteins (1994) cut off level of .70. The values reported in this study were in line with the levels reported for the American version (Spielberger & Reheiser, 1994a; Spielberger & Vagg, 1999). Test-retest reliability showed on all scales a large and positive correlation between the first and second measure. The concurrent validity for JSS was evaluated by using the PSQ instrument (Bergdahl & Bergdahl, 2002; Levenstein et al., 1993) as comparison, and the pattern of correlations between the JSS and PSQ indicated good concurrent validity in the JSS instrument.

Concerns have been raised over the similarity in the factor structure between severity and frequency. These variables are meant to measure different aspects of stress (Kasl, 1998; Vagg & Spielberger, 1998). The similarities in factor structure raise questions about the independence of the severity and frequency variables. Kasl (1998) argues that substantial correlations between Severity and Frequency would undermine the claim that Frequency yields new information. However, the results from the present study show that correlations between Severity and Frequency are only low to moderate. On the other hand, results from the test-retest study showed a significant decline in mean value between the first and second measurement for the Severity and Frequency scales. This finding indicated that ratings of severity and frequency were not completely detached from each other. Another finding that may be taken as evidence for the importance of frequency was that frequency had stronger impact than severity on the different index scales.

In summary, the overall conclusion of this study was that the present version of JSS shows a stable factor structure, satisfactory reliability, and high concurrent validity.

## **Study II**

Holmström, S., Molander, B., & Barnekow-Bergkvist, M. (2007). Gender, occupation, and item bias: Job stress assessed by Job Stress Survey. Manuscript submitted for publication.

When evaluating self-report instruments care must be taken so that measurements are appropriate for different important subgroups (e.g., gender, age, occupation, occupational level). If there are differences in response patterns between subgroups, this can be a sign of item bias known as differential item functioning (Smith, 2002; Swaminathan & Rogers, 1990; Zumbo, 1999). Differential item functioning (DIF) exists if one or more item is more difficult, discriminating, or easily guessed for one group than for another. For example, all persons at a given stress level should have the same probability of endorsing an item in the same way regardless of group membership (Osterlind, 1983).

In this study the main purpose was to analyse the Swedish version of JSS (Holmström et al., 2004; Holmström et al., 2008) with respect to the problem of differential item functioning, and with special attention to the subgroups of gender and occupation (assembly industry workers and medical service personnel). Perceived severity, frequency, and overall occupational stress for subgroups of gender and occupation (metal industry workers and medical service personnel) were analysed as well.

The participants were 1186 employees working in metal assembly industry and in medical service in northern Sweden. Analyses for DIF were conducted in two stages. First, gender and occupation in the whole sample were examined. The two subgroups showed an even distribution between men and women in the gender subgroup. Second, gender was examined in each of the two occupational groups, that is, in the medical service and assembly industry groups. The gender breakdown within the occupational subgroups showed an imbalance, that is, the percentage of men in the industry subgroup was 78.8 %, and the percentage of women in the medical subgroup was 77.5 %.

In the analyses of gender performed on the whole sample there were no items that met the criteria for DIF, neither in the main scales, nor in the subscales. In the analyses of occupation, on the other hand, DIF was found in a total of eight items. Five of these items appear in frequency scales and three of these five items also appear in index scales.

It is noteworthy that there was no item in the Severity dimension that exceeded the criteria for DIF. Most of the items that showed DIF were found in the Frequency dimension, which may be a sign of the differences in the structure of the organization and work settings between metal industry and medical service.

The MANOVAs on item level showed significant multivariate effects for both the Severity and Frequency dimension of JSS for gender, occupation, and for the interaction between gender and occupation. Women have generally higher mean values than men in the Severity and Frequency items, and the ANOVA post-hoc tests showed that women had significantly higher mean value ratings in fourteen Severity items and in three Frequency items.

In the occupational subgroup, post-hoc tests showed that medical service personnel had higher mean values than assembly industry personnel on twenty-three of twenty-nine Severity items, and seven of them were significant. Metal-industry personnel had seven items with higher mean value, and three of them were significant. In the Frequency dimension there were twelve items that showed significant differences, eleven of which with higher mean values for medical service personnel.

The same gender trend as at the item level was noticeable at the scale level, and there were significant main effects for gender on five of the nine scales. There were deviations in mean values between different occupations. Medical service personal had higher mean values on seven of the JSS scales and subscales, and three of the scales showed a significant difference.

The main findings of this study were that both gender and occupation had a substantial impact on specific sources of occupational stress as assessed by JSS scales and individual items. The results support the conclusion that the differences in response pattern for the actual items depend on differences in work settings in the two occupational groups. These results strengthen previous findings concerning gender effects of stress in work places, and suggest that increased attention should be directed to DIF analyses in studies on differences in perceived stress between occupational groups and branches of occupations.

### **Study III**

Holmström, S., Molander, B., & Barnekow-Bergkvist, M. (2008). Work-related stress and musculoskeletal problems in metal industry: A longitudinal study. Manuscript.

The main purpose of this study was to examine the longitudinally relationships between different types of self-reported stress and health, especially the relationships between stress and musculoskeletal complaints. Another aim was to find out how lack of social support relates to musculoskeletal complaints. A further purpose was to examine the present version of JSS (Holmström et al., 2008; Spielberger & Vagg, 1999) with respect to health.

It is well known that high level of stress is associated to musculoskeletal complaints and pain (e.g., Lundberg et al., 1994; Siivola et al., 2004). Risk factors for musculoskeletal diseases are physical, psychosocial, or individual factors (Ariëns et al., 2001). Reviews of the physical and psychosocial factors (e.g., Ariëns et al., 2000, 2001; Hoogendoorn et al., 2000; Larsson et al., 2007; van der Windt et al., 2000) show that physical factors, such as repetitive movements, awkward postures, high force demands, work posture, vibration are important, as well as, psychosocial factors, such as low co-worker support, high quantitative demands, low job control and low job satisfaction. These factors might be associated with musculoskeletal disorders directly, or as a consequence of raising the level of stress in the work place.

Social support has been found to reduce risk for different problems, such as back pain (e.g., Clays et al., 2007; Hartvigsen et al., 2004; Hoogendoorn et al., 2000), pain in neck and shoulder (e.g., Ariëns et al., 2001; Bongers et al., 2006; Larsson et al., 2007) or musculoskeletal problems in general (e.g., Woods, 2005). Social support is not often seen as a factor of stress, and through the use of the JSS instrument we were given an opportunity to compare the relationship between health and the

two subscales Lack of Organizational Support and Job Pressure. A further advantage of the JSS instrument was that it made it possible to consider both the severity and the frequency of the stressors.

The study was performed on participants from two comparable metal and assembly factories located in the same town in northern Sweden. Data were collected at four points, the first in November 2001, the second six months later, and then every 12th month. All employees at the two factories were asked to participate in the study, at time T1 there were 73 people employed at factory A, and a response rate of 74.0 %. Factory B had 70 people employed and the response rate was 87.1 %. The longitudinal sample consists of 56 employees who participated in all four measures, and they were evenly distributed within the two factories.

The level of stress was high at both factories, and compared with Swedish norms for metal industry work-places (Holmström et al., 2008; Molander, Holmström, & Jansson, 2007) the level of stress measured by the JS-X scale was well above average, and close to the 70th percentile. This means that employees at both factories may have experienced levels of stress which are likely to have severely affected their functioning at the workplace, and might also have been a serious threat to their health. MANOVA was used when comparing the two factories for work-related stress and subjective health, the results showed no significant differences. This means that both factories have similar levels of work-related stress and health at the four measurement points. The 2 (Factory) x 4 (Time of Measurement) ANOVAs were done to analyse stress and health in the longitudinal sample, the result showing significant main effects for JS-S, JP-S, and for a psychosocial composite measure ( $p < .03$ ). Also, for both JSS scales there were significant Factory x Time of measurement interactions ( $p < .005$ ). For factory B, the interaction indicates a decreasing trend of severity ratings over time, whereas factory A shows a trend of increasing ratings of severity.

Figure 1 illustrates how the scores for the overall job stress scales (JS-X, JS-S, and JS-F) change over the four measurement occasions and between factories for the longitudinal sample of 56 employees as compared to the other participating employees in each factory. It should be noted in Figure 1 that both factories show similar up-and-down patterns with respect to level of stress over the four measurement points. These patterns, which were especially pronounced in the longitudinal sample and for the scales measuring job pressure, are likely to mirror the volume of production in the factories. Unfortunately, objective measures of trade cycle and volume of production were not possible to obtain, but one item in the JSS scales which could be seen as especially associated to

such measures was “Working overtime”. The mean ratings of this item matched the changes in Figure 1 very well.

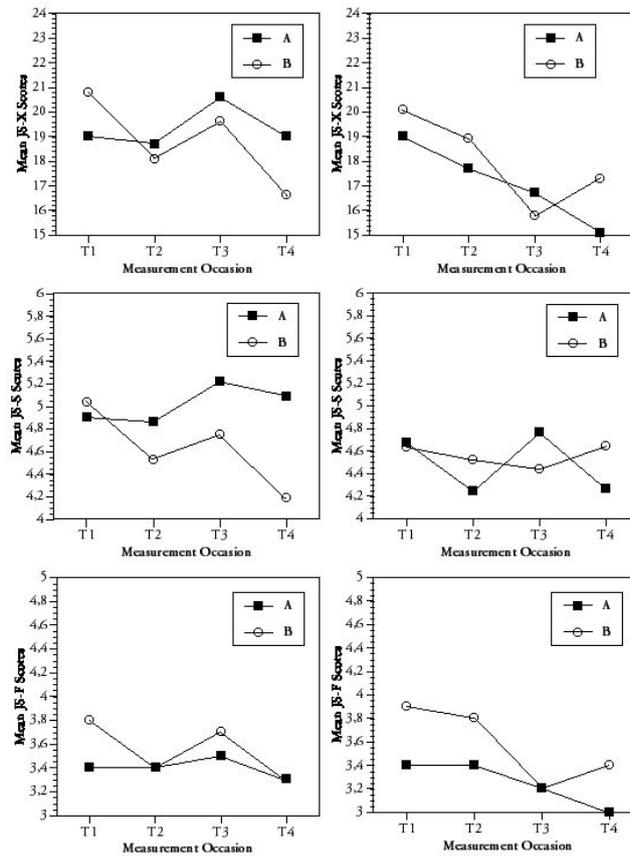


Figure 1. Mean ratings of job stress (JS-X, JS-S, JS-F) as a function of factory and measurement occasion in employees participating longitudinally (left panel) and remaining employees participating cross-sectionally (right panel) (Study III, Holmström et al., 2008).

Mean ratings for musculoskeletal complaints in factory B were higher compared to ratings in factory A, although the latter employees reported higher level of stress. The mean rating levels for back pain, neck pain and pain in shoulders are for both factories not alarmingly high, but they were higher than the mean ratings obtained in a representative sample of other metal industry work sites, and notably higher than what was obtained in the medical sector and in a representative sample of Umeå citizens (Molander et al., 2007). Results from the present study confirm previous studies (e.g., Statistics Sweden, 2006) that back and shoulders are the two

categories with most musculoskeletal problems and that legs and wrists are the two categories with least pain problems.

Results showed quite clearly that LS scales were more associated with pain than JP scales, and these results add to the bulk of findings showing that low social support is an important factor for understanding musculoskeletal pain (e.g., Clays et al., 2007; Hartvigsen et al., 2004; Hoogendoorn et al., 2000). In the present study high correlations were obtained between LS-scales and musculoskeletal complaints for back, neck and shoulders, but also for arms, wrists, and legs. The lack of studies showing effects on lower parts of the body may simply mean that industrial workplaces are underrepresented in social-support studies. The association between Severity and Frequency ratings respectively, and health ratings showed that LS-S scale produced both more significant and higher values on correlations than the LS-F scale. When only selecting LS-items of direct individual concern, correlation levels increased in size, as expected, but only for the LS-S scale. Both the LS-X scale and the LS-F scale showed reduction. This result again demonstrates the difference between severity ratings and frequency ratings, but also points to the importance of keeping different categories of social support in mind when discussing the relationship to musculoskeletal complaints. In reviews of the effects of low social support various categories of support are not always kept apart (c.f. Kristensen, 1995; Woods, 2005).

This study revealed that the variation in the different measures between measurement occasions was larger and more dynamic than expected. It could be that seemingly small changes in production cause quite large changes in the stress and musculoskeletal measures. Some support for this reasoning comes from a comparison between the two factories.

As this study showed, even if the factories are similar with respect to location, cultural values, type of production, structure, and size, such similarities may still be misleading regarding assumptions about equal terms with respect to relationships among stress, musculoskeletal and psychosocial measures. This observation points to the potential problem with scientific reviews, where results from many “similar” factories are averaged, and the problem of selecting suitable control factories in intervention studies.

An important result is that the JSS instrument is well suited for studies of relationships between work-related stress and complaints related to health in the metal industry environment. The relationships with musculoskeletal ratings as well as with ratings of other health problems are strong and significant. JSS scales evaluating lack of social and

organizational support were shown to be more important for the stress-musculoskeletal complaints relationship than scales directed to job pressure.

## GENERAL DISCUSSION

The overall objective of the thesis was to make an evaluation of the Job Stress Survey (Spielberger, 1991; Spielberger & Vagg, 1999). Factor analysis from Study I showed good resemblance between the Swedish version and the American version by providing the same two subscales (Job Pressure and Lack of Organizational Support) for the Severity, Frequency, and Index scales. When analysed on occupational and gender level, similar factor structures were found for both metal industry and the medical sectors, and for men and women. These results confirm previous analyses of the factor structure (Spielberger, 1991; Spielberger & Reheiser, 1994a; Spielberger et al., 2000; Spielberger & Vagg, 1999; Vagg & Spielberger, 1998).

The reliability tests showed that alpha values of internal consistency for different subgroups in the three studies are in line with levels reported by the American version (Spielberger & Reheiser, 1994a; Spielberger & Vagg, 1999). A notable finding from Study I was that the alpha values on the Job Stress scales (Severity, Frequency, and Index) are all above .90. This raises the question of redundancy between some items in the instrument, and that a reduction of the JSS instrument could capture the same underlying features (Helms, Henze, Sass, & Mifsud, 2006). The JSS instrument consists of 30 items, and a reduction of the number of items would give a smaller alpha level on the actual scales, but a reduction in number of items would also mean a loss in variety of work settings.

The test-retest reliability was evaluated and showed high levels for the different scales. Stability coefficients over the different measurement occasions were calculated for the participants included in the longitudinal sample. Stability measures were somewhat low but acceptable (c.f. Loewenthal, 1996). The Swedish version also showed good concurrent validity in comparison with the PSQ (Bergdahl & Bergdahl, 2002; Levenstein et al., 1993).

In Study II, analyses of items demonstrate that both gender and occupation has a substantial impact on specific sources of occupational stress assessed by JSS scales, subscales and the individual items. Thus, it was of importance to assess if the observed differences were due to item bias. Analyses of DIF were carried out with the Ordinal Logistic Regression method (Kristjansson et al., 2005; Zumbo, 1999). The overall results of DIF analyses showed no item bias for the gender subgroup, but for the occupational subgroup. There were a total of eight items which exceeded magnitudes according to both DIF criteria's. Six of the items labelled with DIF for the occupational subgroup were found in the

Frequency (JS-F) and Index (JS-X) scales. There is no clear-cut level for how many items with DIF a scale can handle without being biased for a group (Zumbo, 1999). In this case the overall results show that conclusions made on scale level are not jeopardized because of the DIF items, since they are too few to make an impact on the overall result on the different scales. When comparing or analysing single items on occupational level, caution is needed so that comparisons and conclusions is not based on items showing DIF bias. It is therefore crucial to make DIF analyses to identify biased items in important subgroups, and conducting analyses of DIF should be routine when comparing groups, but also when instruments are developed and translated. If this is done the quality and the precision will increase, and most importantly, any implications drawn will be more correct.

The findings in Study II support the conclusion that the differences in response pattern for the actual items depend on variations in work settings between the two occupational groups. One such difference of possible importance is that one group has more of a person-to-person interaction (medical service personnel) and the other group more of a person-to-machine interaction (metal industry personnel). The results of the analyses on scale and item level showed numerous gender differences in the severity and frequency of occurrence of specific JSS stressors. The findings in Study II confirms earlier studies in that women in general report more stress (Narayanan et al., 1999; Nolan-Hoeksema, 1990; Spielberger & Reheiser, 1994a; Spielberger & Vagg, 1999; Vagg et al., 2002), more interpersonal stressors than men (Treaster & Burr, 2004), and have higher levels on both the Severity and on the Frequency items (Krajewski & Goffin, 2005; Narayanan et al., 1999; Spielberger & Reheiser, 1994b; Spielberger & Vagg, 1999; Triosi, 2001) compared to men. The results from Study II shows that there are differences in both gender and occupation on both scale and item level, which indicates that it is important to develop separate norms for gender. This has also been done in the original JSS version (Spielberger & Vagg, (1999) as well as in the development of the Swedish version (Holmström et al., 2008). Similarly, there is need for developing separate norms for specific work groups that perform similar duties and tasks, and for occupational level. This would help interpretation of gender differences.

Another purpose with this thesis was to evaluate the JSS instrument with respect to relationships with musculoskeletal problems and several other psychosocially related problems, such as stomach pain, tiredness, and worry. The result from Study III showed that the JSS instrument is well suited for studies of relationships between work-related stress and

complaints related to health in the metal industry environment. The relationships with musculoskeletal ratings as well as with ratings of other health problems were differentiated and significant. However, musculoskeletal and psychosocial variables seem to be better predictors than the stress scales when to predict musculoskeletal complaints later on. The findings points to the fact that stress do not have a direct effect on musculoskeletal complaints, but mediating roll.

It was found quite clearly that support scales (LS) were more associated with pain than pressure scales (JP). These results add to the bulk of earlier findings showing that low social support is an important factor for understanding musculoskeletal pain (e.g., Clays et al., 2007; Hartvigsen et al., 2004; Hoogendoorn et al., 2000). Most findings reported in the literature on the relation between support and musculoskeletal pain related to pain in neck, back pain, and pain in shoulders. There are only a few studies which report associations to other body parts such as wrists, arms, and hands. Even rarer are reports of effects for lower parts of the body. Employees in the metal industry group in Study III showed high correlations for back, neck and shoulders, but also for arms, wrists, and legs. The lack of studies on lower parts of the body may simply mean that industrial workplaces are underrepresented in social-support studies and reviews. Social support components can be defined and categorised in different ways (e.g., Berkman, Glass, Brissette, & Seeman, 2000; Cohen, 2004; Woods, 2005). When making calculations using only LS-items of direct individual concern, the correlation coefficients increased in size, as expected, but only for the LS-S scale. Both the LS-X index scale and the LS-F scale showed reduced sizes. This shows the importance of keeping different categories of social support in mind when discussing the relationship to musculoskeletal complaints.

The psychometric quality of the Swedish version of the JSS instrument is high, as shown by this thesis. Results from Study III showed that JSS is useful when examining relations between stress and health. Kasl (1998) have criticized JSS for lacking in questions dealing with monotonous jobs and person-to-machine interactions. The main purpose with the JSS is to measure generic sources of occupational stress encountered in a wide variety of work settings. The gain of using generic stress instrument is that the result can be compared with other departments or organizations. However, the result from Study III points out that it will be useful to complement the JSS instrument with some instrument for measuring stress caused by the manufacturing itself that is, different products or services may involve different levels of trouble along

the line. Stress data closer to the production could help increase the understanding of the sometimes fast-changing stress-musculoskeletal relationships.

### **Severity and frequency ratings of stressors**

When developing the JSS instrument Spielberger and colleagues followed the recommendation of DeFrank (1988) and Dewe (1989) to give more attention to both the perceived severity of the stressor, and the frequency of the stressor. Both of these variables need to be taken into account to get a more complete understanding of the stress experience in different occupations or groups of employees, and it appears that both perspectives are equally important for evaluating occupational stress (Vagg & Spielberger, 1998). According to Spielberger (1983), the difference between perceived severity of work-related stressors and how often they are experienced is comparable to distinguishing between emotional states and traits. Motowidlo, Packard, and Manning (1986) noted in their study that stressful events appear to be functions of both external work conditions and personal characteristics, while perceived severity is influenced primarily by the latter. In Kasl's (1998) review of the JSS some concern was raised over the independency of the severity and frequency variables. Kasl argues that the similarity in the factor structure between Severity and Frequency undermine the claim that frequency is an independent variable that yields new information. He points out that substantial correlations between Severity and Frequency scales would undermine this claim. Findings in Study I showed moderate levels of correlation between Severity and Frequency scales. Result from the test-retest in Study III showed a significant decline in mean value between the first and second measurement for the JS-S and JS-F scales. This finding indicates that severity and frequency ratings are not completely detached from each other. The findings in Study III and in Spielberger and Vagg (1999) showed that the Frequency scales had bigger impact than the Severity scales on the total Index scales. The result in Study III showed that severity ratings are more important than frequency ratings for the LS relationships with musculoskeletal pain. The LS-S scale produced more significant correlations and higher values than the LS-F scale. The lesser importance of LS-F in the context of associations with musculoskeletal ratings may simply be due to the focusing on present situation in the latter ratings, and an addition of rated duration of pain to such measures could change the picture.

### **Further evaluation and development of the JSS**

It is important to make a careful and thorough evaluation of the original instrument to find out how it works in different settings and in various occupational groups. An important part of the process of establishing cross-cultural construct validity is to calculate and evaluate the psychometric properties of the adaptations of the instrument in various countries. After that, changes can be made and new versions be developed.

The standard stressor “Assignment of disagreeable duties,” the item which the other twenty-nine Severity items were compared to, had in previous research been given an average rating by participants from different occupations (Grier, 1982; Spielberger et al., 1981), and therefore this stressor is given a fixed midpoint value of 5 in the Severity scale. In the Spielberg and Reheiser (1994b) study, the ranks for the standard stressor item were thirteen and sixteen for women and men, respectively. Spielberg and Reheiser interpret this result as additional evidence that the standard stressor is about average in perceived severity as compared to the other JSS items. However, the conclusion that Spielberg and Reheiser make is too swift, because the respondents have not actually made any assessment of this stressor and comparisons with other items are therefore not especially meaningful. Hodapp, Tanzer, Korunka, Maier, & Pestemer (2005), showed in their study that the German translation of the standard stressor did not evoke the same amount of stress for all respondents. This is a cross-cultural problem, which should be given more attention in the future.

More attention should also be given to the different ratings of Severity and Frequency. In the original version of JSS, Severity and Frequency ratings are combined into the Index scale. One important issue to evaluate in the future is when different combinations of Severity and Frequency ratings results in the same levels of stress in the Index scale. For example, if one participant rates 3 on a Severity item and 3 on a Frequency item, then the Index will be 9. On the same item, another participant makes ratings of 9 and 1 respectively, and a third participant makes a rating of 1 and 9. For all three items the score on the Index scale will be 9, however, it may be unlikely that the participants perceive stress in the same way. The present version of the test makes no such distinction, and in the future more attention should be given to evaluate whether Severity and Frequency ratings should have the same influence on the Index scale.

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